

FAMINE FOODS OF THE NORTHERN AMERICAN DESERT BORDERLANDS IN HISTORICAL CONTEXT

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ABSTRACT.—Many types of foods are used when more preferred foodstuffs are unavailable, for example, during food shortages. Famine foods used by indigenous peoples of southwestern United States and northernmost Mexico, the Desert Borderlands, are enumerated. Through comparison with prehistoric dietary data, it is then argued that patterns of food preference in the study region changed within the past 400 years, since European contact, colonization, and domination. It is further suggested that myth and ritual are especially important vehicles for transmitting the knowledge of famine food use between generations, because this category of ethnobotanical knowledge is easily lost.

RESUMEN.—Muchos tipos de alimentos se emplean cuando los víveres preferidos no están disponibles, por ejemplo durante carestías. Se enumeran los alimentos de hambruna usados por los grupos indígenas del suroeste de los Estados Unidos de Norteamérica y el extremo norte de México, el área de frontera desértica. A través de la comparación con datos dietéticos prehistóricos, se argumenta a seguir que los patrones de preferencia alimentaria en la región estudiada han cambiado en los últimos 400 años, a raíz del contacto, colonización y dominación europea. Se sugiere además que el mito y el ritual son vehículos especialmente importantes para transmitir de generación en generación el conocimiento del uso de alimentos de hambruna, puesto que esta categoría de conocimiento etnobotánico se pierde fácilmente.

RÉSUMÉ.—Les peuples emploient un grand nombre de sortes d'aliments quand les aliments préférés ne sont pas disponibles, par exemple, pendant les périodes de manque de vivres. Ici les auteurs énumèrent les aliments de famine employés par les peuples indigènes du sud-ouest des Etats-Unis et du Mexique du Nord extrême et des Terres-frontières désertiques. Par comparaison avec des data sur le régime de nourriture préhistorique, nous proposons que les modèles de préférences alimentaires dans la région étudiée se sont transformés pendant les 400 ans passés, dès le contact européen, la colonisation, et la domination. Nous suggérons de plus que les mythes et les rites sont des moyens spécialement importants pour la transmission de la connaissance des aliments de famines entre les générations parce que cette catégorie de connaissance ethnobotanique est très facilement perdue.

Through want and hard hunger they gnaw at the dry and desolate ground, they pick mallow and the leaves of bushes.

—JOB 30:3

INTRODUCTION

Not all foods are equal. Some are relished, others only tolerated, and still others are loathed, being eaten only when necessary. On occasion the Trobriand Islanders, for example, "have to fall back on the despised fruit of the *noku* tree, which is hardly edible but hardly ever fails" (Malinowski 1935:16). As should be the case, greatest scientific attention concentrates on the most common foods. Yet this emphasis should not blind us to the value of studying less desirable foods, often called "famine foods," "starvation foods," "emergency foods," or "queer foods" as so quaintly termed by Kagwa (1934).

Here, I briefly examine the ethnobotanical literature on famine food use by indigenous groups of the Desert Borderlands, emphasizing agriculturalists but also including information on other groups in the southwestern United States and northernmost Mexico. After reviewing general characteristics and importance of famine foods, specific examples from the Desert Borderlands are enumerated. Then I outline a historical process of change in food preference patterns under changing socio-political contexts and suggest that famine food use has changed dramatically through time since European contact. This illustrates that food preference patterns are clearly embedded within their social, economic, historical, and political contexts and are not simply a function of the biological character of these plants.

Characteristics of famine foods.—Famine foods must meet two minimal characteristics. First, they have to be edible, and second, they must be available even when more frequently consumed rations cannot be acquired. Famine foods can often barely claim the first and may require substantial processing to make them edible or to reduce their toxic constituents. The second characteristic is particularly interesting, because we might be able to predict what classes of resources will be famine foods based on their biological character and ecological requirements. Some of the most important famine foods should be those plants that are especially resistant to the factors which reduce yields of more preferred foods. When droughts are the primary factor reducing food procurement, then drought resistant plants should be important famine foods. Most likely these will be xerophytic plants, such as cacti, perennials, or plants growing in environments not affected by precipitation deficits. When predation is a primary limiting factor, plants with particularly effective biochemical or structural defenses against predation should be major famine foods.

Just as food shortages range from "hunger seasons" (e.g., Richards 1939; Annegers 1973; Ogbu 1973; Colson 1980) to massive famines, so too there are various types of low preference foods. First are foodstuffs consumed only during severe food shortages. In addition, traditional populations often endure seasonal periods of low food availability, and there are "seasonal hunger" foodstuffs eaten at these times. Another category of low preference foods are those that are normally consumed and whose use is intensified during periods when other foods are unavailable. An example of the latter group is mesquite fruits (*Prosopis glandulosa*) which are staples for some groups of the Desert Borderlands. During

times when crops fail, the collection of these plants simply may be increased. Century plant (mescal, *Agave*) and various cacti are other examples of widely and frequently consumed native food resources in the Desert Borderlands which also provide an unusually stable resource during food shortages. The Seri on the coast of Sonora, Mexico, present an example:

During extended droughts ephemerals fail to appear, substantially fewer century plants are edible because they do not become reproductive, and many other major perennials have reduced production. Nevertheless, it appears that most Seri were able to locate edible plants at any time of the year. During extended drought on San Esteban Island, however, the only plant available was *Agave cerulata*, which is rich in carbohydrates but low in protein and lipids. (Felger and Moser 1985:95)

The status of a particular plant as a famine food is dependent upon many factors including its biological and biochemical constitution. Some low preference foods have toxic constituents which cause discomfort after eating, yield products of low nutritional value, are foul-tasting, or their consumption requires substantial processing to render them edible. Alamgir (1980:121) reports from Bangladesh that "starvation and the use of alternative 'famine foods' led to epidemics of diarrheal diseases in many areas." Similarly, Irvin (1952) mentions several examples of the deleterious effects due to the consumption of famine foods in the Sudan and other areas of Africa. Other biological factors determine whether a foodstuff might be used only as famine food. These can include low population densities, irregular production, or availability at the wrong time of the year.

Variables other than resource biology are important in understanding famine foods; cultural factors are, likewise, critical. Some low preference foods are tabooed to all or a portion of a population. Ritually tabooed foods, however, are known to be consumed during periods of starvation (e.g., Honigman 1954; Cerulli 1964), and it is quite likely that this practice is more frequent than reported. Seed stock saved for future planting is clearly a famine food of last resort for farmers because of the long-term consequences of this action. Plantain saplings, for example, are a famine food in parts of Bangladesh (Alamgir 1980) as were maize seed among the Hopi (Beaglehole 1937). Agricultural by-products also can be consumed. Of the six major classes of famine foods mentioned for one Bangladesh community, two are agricultural by-products, rice hulls and rice water, not normally eaten by humans (Alamgir 1980). Yue (1985:80-81) illustrates well the use of what would otherwise be crop by-products during a Chinese famine in 1959:

The sent-down cadres organized a group to investigate other ways of obtaining nourishment, by crushing corncobs into powder, for example, and mixing this with a little corn flour to make buns . . . An even cruder kind of bun was made by mixing crushed rice husks and corncobs together with a small amount of ground corn. We also gathered apricot leaves, dried them in the sun, and ground them into flour, sometimes mixing this with powdered elm tree bark to make a porridge. It was a desperate time.

Some resources could be available in the territory of hostile groups, and thus the social cost of use may be quite high. Castetter et al. (1938), as an example, mention that in the past some Pima of the Sonoran desert would not collect the century plant in certain areas because of possible attacks by Apache. Another cultural factor is processing technology. Foods requiring unfamiliar preparation may be less preferred. Various relief rations to Ethiopia were at first not well-integrated into the local cuisine, because these foods were unfamiliar (Mason et al. 1974). Likewise, Woodham-Smith (1962) discusses how the importation of maize in the 1840s during the Irish Potato Famine created confusion, because it was a food unfamiliar to both peasants and administrators.

Finally and perhaps most importantly, the characterization of a food as low preference is, of course, logically dependent upon the availability of more preferred foods. Changes in the foods available, therefore, should change preference patterns. This factor is one overlooked in discussion of famine foods because such studies have tended to be ahistorical. With the introduction of new crops and edible wild foods between areas, the role of native foods can change. I attempt to demonstrate that such a change occurred in the Desert Borderlands during the past four centuries, since Spanish contact and conquest followed by governmental administration by Mexico and then the United States.

Famine foods: importance and frequency.—The study of low preference foods has theoretical and practical value. The use of famine foods seems to be a universal strategy for coping with severe food shortages; it is impossible to estimate how many lives have been spared by the use of these foods. Not only does the study of famine foods document a little known set of foods, but they have characteristics that might be exploitable. These plants survive and can produce food, however tenuous the claim of edibility may be, under extremely unfavorable conditions, and this characteristic may be manipulated in the development of new crops and economic products. It is quite likely that some of these plants could become cultigens if bred to reduce undesirable biochemical properties and other factors limiting use.

Because of infrequent use and lowest status, low preference foods seem to be underrecorded in ethnobotanical literature, even though many such foods surely exist. The use of famine foods is one of the most commonly recorded actions taken by peoples throughout the world to cope with food shortages, based on a cursory survey of the Human Relations Area File. Unfortunately, most of the examples are simply superficial and anecdotal references that rarely identify the famine foods adequately. One example from ancient China does, however, clearly demonstrate the extensive use of famine foods, and I believe accurately reflects the diversity of famine foods. The *Chiu-Huang Pen-ts'ao* published in 1559 describes 414 plant famine foods used in Hunan province alone (Read 1946). Such a large number of famine foods from only one small region suggests that the number of famine foods throughout the world could be truly staggering. A large corpus of folk information on famine foods must reflect their critical importance to humanity. As Scudder (1962:211) states in regard to the Gwembe Tonga of central Africa:

. . . while I believe that a number of these reports are overly optimistic about the ability of wild produce alone to support an agricultural population for extended periods of time without widespread malnutrition and starvation, it cannot be denied that time and again crop failure has led to intensive exploitation of the rich flora of the Valley.

There may be many reasons why the use of starvation foods seems to be reported so infrequently in ethnobotanical literature. Practices of traditional rural peoples who often form the lowest stratum of nation-states are frequently viewed negatively. And most likely the use of famine foods, which are barely edible, might be considered especially "primitive" and suffer a harsh judgement. Consequently, the use of these resources would not be widely acknowledged. Furthermore, with the increasing incorporation of traditional peoples into industrial, national, and international economies, the use of local famine foods surely has decreased as other strategies for coping with food shortages, such movement to urban areas or increasing use of international relief supplies, have gained importance. Combined with increased urbanization, these factors can lead to the substantial loss of information about foods useful during famines. The lack of this knowledge was so acute during severe food shortages in World War II that the Dutch government felt compelled to issue a publication describing emergency food plants locally available and methods for preparing them (Den Hartog 1981).

THE DESERT BORDERLANDS

Environments of the Desert Borderlands vary from the desert coasts, rich with marine resources, through the inland Mohave, Great Basin, Chihuahuan, and Sonoran deserts to the rugged mountains and plateaus of the major continental mountain masses of the Sierra Occidental in Mexico and the Rocky Mountains in the United States (Fig. 1). Deserts basins are low, from less than 305 m in elevation for the Sonoran Desert up to 1,525 m for the Chihuahuan, Great Basin, and Mohave deserts. Precipitation in the deserts is sparse, approximately 200–300 mm per year. Grasslands and desert scrub communities dominate the deserts with relatively lush riparian vegetation along the larger drainages. Low deserts have cool winters, whereas the upland deserts experience cold winters. Major mountain ranges rise up to 4,200 m with precipitation ranging from 305 mm to over 1,020 mm annually. Mountain vegetation is composed largely of conifer woodlands with oaks and coniferous forests at higher elevations. Within these major zones is a great diversity of biological communities that have been most recently described by Brown (1982).

The present natural environments of the Desert Borderlands have undergone significant changes even within the past several hundred years (e.g., Brown 1982; Hastings and Turner 1965; Wauer and Riskind 1977). Many of these changes can be attributed to anthropogenic factors. Severe grazing pressure, hydrological modification, urban development, industrial farming, use of water far beyond recharge rates, and suppression of natural fires, among other factors, have altered

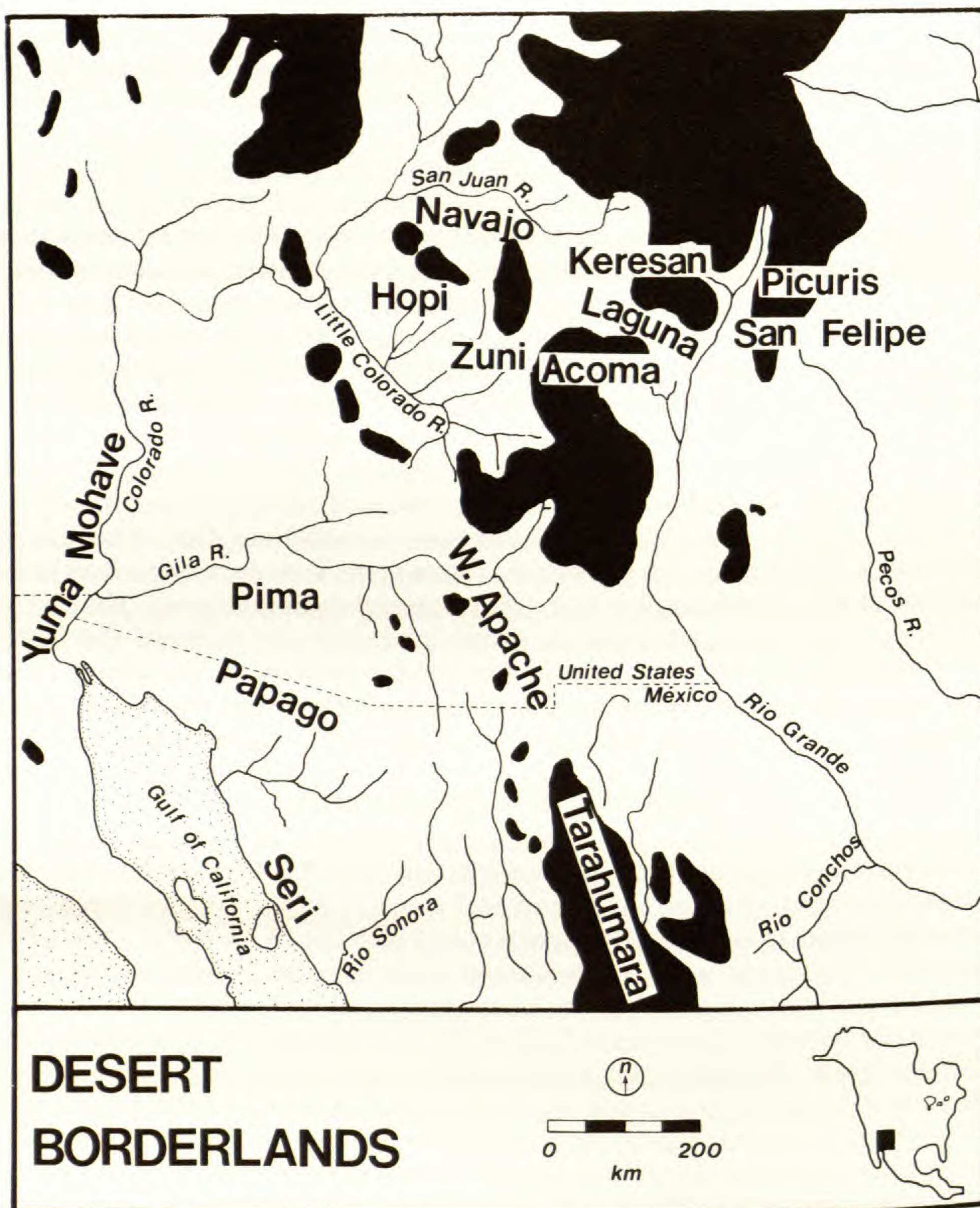


FIG. 1.—Map of the Desert Borderlands of the southwestern United States and northernmost Mexico showing the location of indigenous groups mentioned. The dark areas are major mountains, including the Rocky Mountains in the north, the Sierra Madre Occidental to the south, and the Mogollon highlands in the center of the map.

the environment, including the former distribution of native food plants. Bohrer (1975), for example, discusses the recent widespread reduction of cool-season grasses, whose seeds were once important foods for indigenous peoples.

The cultural environment of this region is, likewise, complex and ever changing; native populations have developed a rich suite of adaptations to the environmental and cultural conditions in the Desert Borderlands. Some groups have been mobile hunters and gatherers, whereas for at least 2000 years, others have been farmers, and more recently some have raised livestock.

The ethnographic present for groups considered here dates from the last century for most cultures to the present for others, such as the Seri. Famine foods have been recorded for the largely agricultural Puebloan groups of the Colorado Plateau and Rio Grande valley (Hopi, Zuni, Acoma, Laguna, San Felipe, San Juan, and Keresans). Agriculturalists of the Sonoran desert or Colorado River are also included (Pima, Mohave, Yuma), as are the Papago, a Sonoran desert group combining more hunting and gathering with agriculture. The Navajo and Ramah Navajo of the Colorado Plateau focus on herding and agriculture, whereas the Seri are hunter-gatherers of the desert coasts of Sonora, Mexico.

The political and economic impacts on native populations by Spanish, Mexican, and North American occupations have been profound and have not been the same for all populations in the Desert Borderlands. While many groups became extinct following European domination of the region, others partially maintained their cultural integrity to varying degrees. Even for those groups that have been marginally integrated into national economies, many changes have affected them. Traditional areas of economic exploitation have been significantly reduced, and new economic pursuits, such as animal husbandry, use of new crops, and sale of crafts, have been added to their economies. The Hopi, often cited as one of the more traditional cultures of the Desert Borderlands, now have a diet composed largely of nonlocal foods with little use of traditional resources (Kuhnlein and Calloway 1977).

Many environmental (e.g., fire, flood, pest infestation) and cultural factors (e.g., conflict, change in economic relationships) can reduce food availability. I believe, however, that one of the primary causes of food shortages in the Desert Borderlands has been unusually low precipitation. Paleoclimatic and historic records demonstrate periods of sustained and widespread droughts, both during prehistoric and historic times (e.g., Tuan et al. 1973; Sellers and Hill 1974; Dean and Robinson 1978; Euler et al. 1979; Dean et al. 1985; Hall 1985; Minnis 1985). Consequently, native populations in the Desert Borderlands have been familiar with food shortages for thousands of years and have developed a repertoire of strategies to cope with these threatening circumstances.

FAMINE FOODS OF THE DESERT BORDERLANDS

Although most references to Desert Borderlands ethnobotany and socio-ecology emphasize only the most commonly used plants, the voluminous ethnobotanical literature does provide mention of some famine foods, even though important characteristics of famine food are now unavailable. We have inadequate understanding of the chemical composition of these resources, methods of preparation, who collects them, and precisely when and how these plants are used.

Table 1 lists probable famine foods recorded for the Desert Borderlands groups considered here. Not all plants listed are famine foods in the most restricted sense; also included are hunger season foods and those foods whose harvest is simply intensified under these conditions. The use of low preference foods is dynamic, yet few references provide sufficient documentation of their use. Therefore, the choice was made to include the widest number of possible famine foods in Table 1.

For sake of discussion, I divide Desert Borderlands starvation foods into seven categories, inner bark, cacti, agave and agave-like plants, other perennials, underground structures, annuals, and other. These categories mirror no indigenous folk classification, but plants within each category share some similarities. Resources availability in the first five groups should be quite stable; their availability is least affected by common environmental fluctuations in the Desert Borderlands. Abundance of food stuffs derived from plants in the sixth category, annuals, in contrast, may well be less stable, and they are, therefore, especially interesting.

TABLE 1.—Famine foods of the desert borderlands.

Plant (common name)	Part Consumed	Group— Comments	Reference
Inner Bark			
<i>Juniperus monosperma</i> (Engelm.) Sarg. (one-seeded juniper)	inner bark	Navajo & others Navajo	Castetter 1935 Elmore 1944
<i>Pinus edulis</i> Engelm. (pinyon)	inner bark	Ramah Navajo	Vestal 1952
<i>Pinus ponderosa</i> Laws. var. <i>scopulorum</i> Engelm. (<i>Pinus scopulorum</i>) (western yellow pine)	inner bark	Zuni Pueblo & others	Castetter 1935
<i>Populus tremuloides</i> Michx. (aspen)	inner bark	Ramah Navajo	Vestal 1952
Cacti			
<i>Carnegiea gigantea</i> (Engelm.) Britt. & Rose (saguaro)	fruit	Papago Seri—possible famine food	Castetter & Bell 1942 Felger & Moser 1974, 1985
<i>Ferocactus wislizensi</i> (Engelm.) Britt. & Rose (barrel cactus)	stem pulp	Seri	Felger & Moser 1976, 1985
<i>Opuntia</i> sp.	stem	Hopi Pueblos	Hough 1897
<i>Opuntia clavata</i> Engelm. (cholla)	stem (?)	Laguna & Acoma Pueblos	Swank 1932

Plant (common name)	Part Consumed	Group— Comments	Reference
<i>Opuntia imbricata</i> Haw. (<i>O. arborescence</i>) (cane cactus)	stem	Laguna & Acoma Pueblos	Swank 1932
<i>Opuntia polyacantha</i> Haw. (prickly pear)	stem	Hopi Pueblos	Whiting 1939
<i>Opuntia whipplei</i> Engelm. & Bigel. (whipple cholla)	fruit	Hopi Pueblos	Whiting 1939
<i>Pachycereus pringlei</i> (S. Wats.) Britt. & Horak (cardón)	fruit	Seri—possible famine food	Felger & Moser 1974, 1985
<i>Stenocereus alomoensis</i> (Coult.) Gibs. & Horak (pitaya agria)	fruit	Seri—possible famine food	Felger & Moser 1974, 1985
<i>Stenocereus thurberi</i> (Engelm.) Buxb. (organ pipe cactus, pitaya dulce)	fruit	Seri—possible famine food	Felger & Moser 1974, 1985

Century Plant and Related Plants

<i>Agave</i> sp. (century plants)	heart of plant (?)	Mohave & Yuma	Castetter et al. 1938
<i>Agave cerulata</i> spp. <i>dentiens</i> (Terl.) Gentry (century plant)	liquid from charred leaves	Seri	Felger & Moser 1970, 1985
<i>Agave parryi</i> Engelm. (century plant)	heart of plant	Pima	Castetter 1935
<i>Dasyilirion wheeleri</i> Wats. (sotol)	heart of plant	—	Castetter 1935
<i>Yucca</i> spp.	heart of plant	"Pueblo Indians of New Mexico"	Castetter 1935
<i>Yucca glauca</i> Nutt. (yucca)	heart of plant	Laguna & Acoma Pueblos	Swank 1932

Other Perennials

<i>Acacia pennatula</i> (palo garabo)	fruit and seeds	"Mexico"	Altschul 1973
<i>Amaranthus</i> sp. (pigweed)	—	Ramah Navajo—used ceremonially and during food shortages	Vestal 1952
<i>Apodanthera undulata</i> Gray	fruit	Pima Bajo	Pennington 1980

TABLE 1.—Famine foods of the desert borderlands. (continued)

Plant (common name)	Part Consumed	Group— Comments	Reference
<i>Atriplex lentiformis</i> (Torr.) Wats. (quail bush)	seeds	Pima	Curtin 1949
<i>Atriplex polycarpa</i> (Torr.) Wats. (all scale)	seed	Pima	Curtin 1949
<i>Baccharis salicifolia</i> (R&P) Pers. (<i>Baccharis glutinosa</i> Pers.) (seepwillow)	greens	Mohave & Yumans	Castetter & Bell 1951
<i>Juniperus monosperma</i> (Engelm.) Sarg. (one-seeded juniper)	fruit	Hopi Pueblos Laguna & Acoma Pueblo	Whiting 1939 Swank 1982
<i>Lycium pallidum</i> Miers. (wolfberry)	fruit	Hopi Pueblos	Whiting 1939
<i>Oryzopsis hymenoides</i> (R&S) Ricker (<i>Eriocoma cuspidata</i>) (Indian ricegrass)	grains	Hopi Pueblos	Castetter 1935
<i>Phoradendron juniperinum</i> Engelm. (mistletoe)	fruit	Lagnua & Acoma Pueblos	Swank 1932
<i>Prosopis glandulosa</i> Torr. (mesquite)	fruit and seed	Pima Hopi Pueblos (?) Yuma	Bell & Castetter 1937 Bell & Castetter 1937 Bell & Castetter 1937
<i>Prosopis glandulosa</i> Torr. var. <i>torreyana</i> (L. Bens.) M.C. Johnst. (western honey mesquite)	fruit	Seri—possible famine food	Felger & Moser 1971, 1985
<i>Prosopis pubescens</i> Benth. (screwbean)	fruit	Pima & Papago (?) Yuma Seri	Bell & Castetter 1937 Bell & Castetter 1937 Felger & Moser 1971, 1985
<i>Quercus grisea</i> Liebm. (gray oak)	fruit	Ramah Navajo— "not good food"	Vestal 1952
<i>Quercus undulata</i> Torr. (wavyleaf oak)	fruit	Ramah Navajo— "not good food"	Vestal 1952
<i>Rhizophora mangle</i> L. (mangrove)	fruit	Seri	Felger & Moser 1976, 1985
<i>Ribes inebrians</i> Lindl. (squaw currant)	fruit	Hopi Pueblos	Whiting 1939
<i>Rosa arizonica</i> Rydb. (rose)	fruit	Hopi Pueblos	Whiting 1939
<i>Simmondsia chinensis</i> (Link) Schneid. (jojoba)	nut	Seri	Felger & Moser 1976, 1985

Plant (common name)	Part Consumed	Group— Comments	Reference
Underground Structures			
<i>Dichelostemma pulchellum</i> (Salisb.) Heller var. <i>pauciflorum</i> (Torr.) Hoover (<i>Brodiaea capitata</i> var. <i>pauciflora</i>) (bluedick, incorrectly cited as "Papago blue bells")	tuber	Papago	Castetter & Bell 1942 Castetter & Underhill 1935
<i>Habenaria sparsiflora</i> Wats. (bog orchid)	bulb	San Felipe Pueblo	Castetter 1935
<i>Solanum fendleri</i> Cav. (nightshade)	tuber	Keresan Pueblos— raw/boiled with clay	White 1944
<i>Solanum jamesii</i> Torr. (wild potato)	tuber	Keresan Pueblos— same as for <i>S. fendleri</i>	White 1944
<i>Sphaeralcea coccinea</i> Pursh. (globemallow)	root	Navajo	Elmore 1944
Annuals			
<i>Acanthochiton wrightii</i> Torr.	greens	Hopi Pueblos	Hough 1897; Castetter 1935; Whiting 1939
<i>Aster spinosus</i> Benth. (spiny aster)	greens	Mohave & Yumans	Castetter & Bell 1951
<i>Chamaesaracha coronopus</i> (Dunal) Gray (small groundcherry)	fruit	Hopi Pueblos	Whiting 1939
<i>Chenopodium</i> sp. (goosefoot)	seed	Ramah Navajo—used ceremonially and during food shortages	Vestal 1952
<i>Cleome serrulata</i> Pursh. (Rocky Mountain beeweed)	greens	Ramah Navajo—used ceremonially and during food shortages	Vestal 1952
	greens seeds	Picuris Pueblo (?) New Mexican Hispanics	Krenetsky 1964 Curtin 1965
<i>Dicoria brandegei</i> Gray	flower/fruit	Hopi Pueblos	Whiting 1939
<i>Mentzelia pumila</i> (Nutt.) T&G (blazing star)	seed	Hopi Pueblos	Whiting 1939
<i>Mentzelia multiflora</i> (Nutt.) Gray (blazing star)	seed	Hopi Pueblos	Whiting 1939

TABLE 1.—Famine foods of the desert borderlands. (continued)

Plant (common name)	Part Consumed	Group— Comments	Reference
<i>Physalis hederaceifolia</i> (Gray) var. <i>cordifolia</i> (Gray) (<i>Physalis fendleri</i> Gray) (groundcherry)	fruit	Hopi Pueblos	Whiting 1939
<i>Solanum triflorum</i> Nutt. (nightshade)	fruit	Acoma & Laguna Pueblos	Castetter 1935
<i>Sonchus asper</i> L. (spiny sow thistle)	greens	Mohave & Yumans	Castetter & Bell 1951
<i>Sysymbrium irio</i> L. (London rocket)	greens	Mohave & Yumans	Castetter & Bell 1951
<i>Thelypodium integrifolium</i> (Nutt.) Endl. (<i>Thelypodium liliacinum</i> Green)	greens	Mohave & Yumans	Castetter & Bell 1951
Other			
<i>Washingtonia filifera</i> Wendl. (desert palm)	stem pith	—	Cornett 1987
<i>Zostera marina</i> L. (eelgrass)	seed	Seri	Felger & Moser 1973, 1976, 1985
“grasses/pigweed/goose- foot” (see <i>Amaranthus</i> & <i>Chenopodium</i>)	seed	Ramah Navajo—used ceremonially and during food shortages	Vestal 1952
cactus/wild potato/grass	?	Hopi Pueblos	Beaglehole 1937

Nomenclature follows Benson 1969; Felger and Moser 1985; Gentry 1982; Lehr 1978; Martin and Hutchins 1980. Non-technical terms are used to describe for plant anatomy (for example, an achene is termed a “seed”). Scientific names in parenthesis are those used in the original citation. Plants listed here include food used only during food shortages, foods used during seasonal shortages, as well as those normally consumed and whose use is simply intensified with low food availability. In the absence of detailed descriptions of the use of possible Desert Borderland famine foods, I decided to include the widest possible range of these resources.

Inner bark.—A widely recorded category of starvation food in the Desert Borderlands is the inner bark (cambium and associated tissue) of various trees; inner bark is not recorded as a “normal” ration (e.g., Swetnam 1984). There is ethnographic documentation of inner bark use of the pinyon pine (*Pinus edulis*), one-seeded juniper (*Juniperus monosperma*), western yellow pine (*Pinus ponderosa* var. *scopulorum*), and aspen (*Populus tremuloides*). This mucilaginous food is widely available and is abundant throughout the forests of the Desert Borderlands.

More importantly, it is a very stable resource. Environmental variation which reduces the availability of edible flowers, fruits, and seeds would be less likely to affect adversely the abundance of viable inner bark. Perhaps the factor limiting normal use of this resource is its probable low nutritional value and the considerable effort required to harvest sufficient quantities. Furthermore, sustained harvest of inner bark might seriously reduce tree populations.

Why is the inner bark of only certain plants utilized as famine food? Hundreds of different woody plants are present in the Desert Borderlands, yet the ethnobotanical record lists very few plants with edible inner bark. Many of the plants recorded to have edible inner bark are conifers which have easily removable bark. This alone cannot explain the pattern of use, however, because there are numerous conifers not cited as yielding edible inner bark.

Cacti.—Native peoples throughout the Desert Borderlands have long used cactus fruits as food. Saguaro fruits (*Carnegiea gigantea*) have been a major food for groups living within its range. The Seri use the fruits of several columnar cacti. The stems, joints, and pads of cacti, such as *Opuntia* (prickly pears and cholla), have been widely used by some groups throughout the Desert Borderlands.

The use of cacti as a famine food is well documented for indigenous peoples in the Desert Borderlands. By their nature, cacti are well adapted for survival and reproduction during periods of severe drought, a primary cause of crop failure. According to Felger and Moser (1974, 1985), the exploitation of various cacti, such as saguaro, cardón (*Pachycereus pringlei*), pitaya agria (*Stenocereus alomoensis*), and pitaya dulce or organ pipe cactus (*Stenocereus thurberi*), is increased during droughts, and the Seri also use the pulpy "stem" of the barrel cactus (*Ferocactus wislizeni*) as a famine food. Other cacti are also recorded as famine foods. The Pueblo Indians of Acoma, Laguna, and Hopi use various species of *Opuntia*, both cholla and prickly pear, during food shortages.

Century plant and related plants.—The century plant (*Agave*) and agave-like plants (*Yucca*, *Nolina*, and *Dasyllirion*) are important foods for many groups in the Desert Borderlands and seem to have been prominent famine foods. These plants are perennial, can store enormous amounts of tissue, and can survive severe droughts. As cited earlier, at least one group of Seri rely on *Agave cerulata* when other foods are unavailable. The Pima, Mohave, and Yuma are recorded to have used the century plant (including *A. parryi*) as a starvation food. The stem of *Yucca glauca* is reported as a famine food at Acoma and Laguna. Sotol (*Dasyllirion wheeleri*) is a famine food, although the group using sotol in this manner is not specified.

Other perennials.—We would expect many famine foods would be the reproductive structures of perennials, because some of them would be especially resistant to the effects of low moisture periods. The fruits of the one-seeded juniper (*Juniperus monosperma*) are a famine food for the Hopi, Laguna, and Acoma Indians. The bitter fruit of coyote melon (*Apodanthera undulata*) is a famine food among the Pima Bajo of central Sonora. The fleshy berries of the wolfberry (*Lycium pallidum*), squaw currant (*Ribes inebrians*), and the dry fruits of a native rose (*Rosa arizonica*) are Hopi famine foods. Fruits of a mistletoe (*Phoradendron juniperum*),

a parasite on conifers, are a famine food for the Puebloans of Acoma and Laguna. Mesquite (*Prosopis glandulosa*) and screwbean (*Prosopis pubescens*) are recorded as a possible famine food for the Pima, Papago, Yuma, Seri, and Hopi. Mesquite and screwbean seeds are often used as famine foods, whereas the mesocarp of the pods is the preferred food. Acorns (*Quercus grisea*, *Q. undulata*) may have been famine foods for the Ramah Navajo, a group living east of Zuni Pueblo. A note on a herbarium specimen from Mexico collected by H.S. Gentry noted that the fruits (with enclosed seeds) of *Acacia pennatula* were used as a famine food in Mexico. Mangrove (*Rhizophora mangle*) and jojoba (*Simmondsia chinensis*) fruits are consumed by the Seri when more preferred foods are unavailable. The seeds of several saltbushes (*Atriplex lentiformis* and *A. polycarpa*) are recorded as famine foods among the Pima.

Many grasses are present in the Desert Borderlands, and they are important foods. Yet there are only a few references to unspecified grasses as famine foods, and only one specific grass, Indian ricegrass (*Oryzopsis hymenoides*), is listed as a famine food. This perennial has several characteristics that make it a particularly valuable food for humans. It was once present in dense stands, it matures early, has a relatively high protein content, and the seeds tend to remain on the plant longer than in many grasses. Its use as a famine food is enhanced by notable drought tolerance (Hanson 1972; Quinones 1981).

"Greens" (probably leaves or young stems) of only one perennial tree or shrub, seepwillow (*Baccharis salicifolia*), is recorded as a famine food for the Desert Borderlands. This is of interest in light of the numerous foodstuffs in other areas of the world which are derived from tree or shrub leaves. As a comparison, over half of the foods listed in the *Chiu Huang Pen-ts'ao* are leaves, and many are from woody plants (Read 1946).

Underground structures.—Another category of unusually stable resources used as famine foods is "tubers" and roots. The availability of these resources should be quite stable. Wild potato (*Solanum jamesii*, *S. fendleri*) tubers are famine foods for Puebloan groups of New Mexico. To counteract their naturally bitter taste, salty clay is added to the mashed tubers. People of San Felipe Pueblo are documented to have used the "bulb" of *Habenaria sparsiflora* as a famine food. Globemallow (*Sphaeralcea coccinea*) roots are a Navajo famine food. Bluedick bulbs (*Dichelostemma pulchellum* var. *pauciflorum*), incorrectly identified by Castetter and Bell (1942) as Papago blue bells, are a famine food for the Papago.

Annuals.—The sixth group of famine foods, annuals, is especially interesting because foodstuffs derived from these plants should be more susceptible to drought conditions, a primary cause of food shortages in the region. Many annuals simply fail to germinate during low moisture conditions. Consequently, we could expect them to be relatively unimportant famine foods. However, numerous annuals are listed as famine foods. The Hopi are reported to use immature *Acanthochiton wrightii* as greens, and Rocky Mountain beeweed (*Cleome serrulata*) is consumed in a similar manner by the Ramah Navajo. Greens of other plants (*Aster spinosus*, *Sonchus asper*, *Sysymbrium irio*, and *Thelypodium integrifolium*) are famine foods among the Mohave and Yuman groups, although the middle

two are Euro-Asian weeds introduced in the region since European contact. Hispanics of northern New Mexico use Rocky Mountain beeweed seeds as a famine food. Hopi famine foods also include the fruits of the groundcherry (*Physalis hederæefolia* var. *cordifolia*) and small groundcherry (*Chamaesartha coronopus*). The fruits of a nightshade (*Solanum trifolium*) are a famine food at Acoma and Laguna. The small dry "seeds" of pigweed (*Amaranthus*), goosefoot (*Chenopodium*), and blazing star (*Mentzelia pumila*, *M. multiflora*) are eaten by the Hopi when other foods are unavailable. The seeds and flowers of another annual, *Dicoria brandegei*, are famine foods for the Hopi.

As will be discussed later in more detail, the greater than expected number of annuals listed as famine foods might be due to a historical change in famine food classification, where plants once used as hunger season foods became today's famine foods.

Others.—Two plants recorded as famine foods do not neatly fit into the above categories. Eelgrass (*Zostera marina*), a marine plant, is extensively used by the Seri and may have been a famine food. Needless to say, this aquatic plant is not as affected by low precipitation as are terrestrial plants. The pith of the desert fan palm (*Washingtonia filifera*) is used as a famine food. In many ways, this resource is analogous to the hearts of the century plant, although its nutritional composition may be quite different.

DISCUSSION

The use of famine foods is a complex phenomenon involving a multitude of both biological and cultural factors. Simple enumeration of available famine foods, a worthy goal itself, does not, however, allow us to appreciate the dynamic nature of their use. Here I will discuss various aspects critical for an understanding of famine food use. First discussed is the historical change in famine food use, and I will argue that food preference patterns may actually encapsulate the history of changing diet. Therefore, patterns of famine food usage makes little sense without a historical perspective. Second is a consideration of how human populations transmit knowledge of famine foods to a new generation. How is knowledge of infrequently used resources maintained in a community, especially if use of famine foods occurs less than once per generation? I suggest that ritual and myth are unusually important in maintaining knowledge famine foods within a community. Thirdly, it is suggested that use of famine foods may be an indicator of the severity of food shortages. Finally, the value of a cross-cultural and comparative perspective on famine foods is briefly considered.

Historic change in famine food use.—In light of the hundreds of useful plants recorded in the ethnobotanical literature of the Desert Borderlands, relatively few famine foods are discussed. Undoubtedly, there are many unreported resources which have been used as famine foods by the indigenous populations in the region, and it is quite likely that much of the inventory of traditional famine foods has been lost since European contact and before intensive ethnographic documentation began around 100 years ago.

I suspect an additional dimension is also an important reason for the few famine foods recorded. By the time ethnographers recorded the ethnobotany of most native peoples in the area, many of these peoples had dramatically altered their subsistence base. Such changes included the introduction of new crops, new agricultural technology, animal husbandry, increased sedentism, and substantial involvement in market economies. I argue that traditionally important foods had been relegated to less frequent use. Some of these plants then became potential famine foods. In short, the introduction of a new set of resources caused a resorting of general food preference patterns with some newly acquired plants replacing some former foods and these in turn becoming less commonly used. Previous famine foods were then replaced by what were once more common foods. And the knowledge of the "original" famine foods may have been completely lost. Specifically, many of the famine foods recorded for modern groups in the Desert Borderlands may well have been seasonal hunger foods.

If this scenario is correct, then it provides an explanation for the unexpectedly large number of annuals now considered famine foods. If periods of low precipitation were the major cause of food shortages, as I believe, then one needs to understand why so many annuals are now viewed as famine foods. After all, annuals presumably would be one of the first groups of plants adversely affected by insufficient moisture. Drought resistance, however, would not necessarily be a characteristic important for hunger season plants. A shift of hunger season plants to famine foods could account for a large number of annuals being considered famine foods.

Prehistoric diet provides a needed comparative baseline to document change in famine food use through time, because it can be difficult to estimate how frequently these current famine foods were used by the prehistoric peoples of the Desert Borderlands. Many of the plants listed ethnographically as famine food seem to have been more common food plants before European contact. Grass (e.g., *Oryzopsis hymenoides*), pigweed (*Amaranthus* spp.), and goosefoot (*Chenopodium* spp.) seeds, for example, are now considered famine foods and are common prehistoric food remains found in archaeological sites in the Desert Borderlands (e.g., Adams 1980; Minnis 1985; Wetterstrom 1986).

Perhaps the best paleodietary data to evaluate a model of changing food preference come from prehistoric feces, because these data are the direct remains of consumed food. The most extensive coprolite data come from cliff dwellings in a northern portion of the region, the Four Corners area of the United States. These dessicated fecal remains are from the prehistoric Anasazi tradition, one of many prehistoric populations ancestral to modern Puebloan groups. The fecal content information can be used as a controlled comparison between ethnographically documented famine food use by the Hopi, a modern Pueblo group in the Four Corners area, and an ancestral prehistoric Puebloan diet in the same region.

A recent summary of paleofeces shows that many plants now recorded as famine foods are some of the most frequent native plants found in these coprolites (Minnis 1989). Of particular interest for the purposes of this study are 139 paleofeces from the latest prehistoric time period, Pueblo III, A.D. 1100-1300, the time just before European contact and with the best paleodietary data.

Coprolites considered here were recovered from three sites in or near Mesa Verde, southwestern Colorado, (Step House, $n=17$; Lion House, $n=4$; Hoy House, $n=56$), Glen Canyon, southeastern Utah, ($n=24$), and two sites in northeastern Arizona (Inscription House, $n=16$; Antelope House, $n=22$). Macroscopic plant remains, mostly seeds and fruit fragments but also some tissue, were identified in the feces. Most of the analyses summarized in the study simply noted presence/absence of a taxon in each specimen and did not attempt to quantify the amount of each resource in each coprolite.

Cultivated plants, especially maize and squash, were the most commonly consumed foodstuffs, being found in the vast majority of the coprolites studied (Table 2). Of the natural flora, the most common remains from these feces are, in descending frequency: prickly pear, goosefoot, groundcherry, purslane (*Portulaca* sp.), pigweed, ricegrass, grass seeds, cactus, peppergrass (*Lepidium* sp.), pinyon, and Rocky Mountain beeweed. Other plants were identified as very infrequent constituents in these feces, often being found in only a single coprolite.

There is a surprisingly close correspondence between important native foods consumed by the prehistoric peoples of the northern part of the Desert Borderlands and foods ethnographically classified as famine foods within the past century, especially among the Hopi. Whiting (1939:20-22) lists Hopi famine foods: wolfberry (*Lycium pallidum*), cholla (*Opuntia whipplei*), prickly pear (*O. polyacantha*), squaw current (*Ribes inebrians*), wild rose (*Rosa arizonica*), groundcherry (*Physalis fendleri*), Indian ricegrass (*Oryzopsis hymenoides*), and blazing star (*Mentzelia pumila*, *M. multiflora*). Prickly pear, goosefoot, groundcherry, pigweed, ricegrass, grass seeds, and the general category "cactus" are all documented in Table 1 as famine foods and are common prehistoric dietary items (Table 2).

The fact that many of the most frequently consumed prehistoric foods are now classified as famine foods can be explained in one of two ways. First, it can be argued that remains in these coprolites reflect the use of prehistoric famine foods. That is, the paleofeces document serious food provisioning problems. There are two reasons why I believe that this explanation is faulty. First and most importantly, maize is by far the most abundant foodstuff in these coprolites. Maize was found in nearly 90% of the coprolites, and where data are available it often comprises the bulk of feces (Minnis 1989). In contrast, the most common native plant (prickly pear) was noted in approximately 30% of the paleofeces. Maize cultivation, and ultimately yield, are more sensitive to drought than many native foods. Consequently, we would expect some reduction in maize consumption under drought conditions. It is unlikely that maize would be as common as it is in the feces if they are a record of famine food use. Second, the coprolite assemblages represent a time of expanding prehistoric populations and substantial construction of villages in the Four Corners area. If food shortages were so frequent, then it would be unlikely that the prehistoric cultures would have been as expansive.

The second possible explanation is, to my mind, more likely. Many of these resources, which are now famine foods, were basic constituents of the prehistoric diet in the area. Viewed in this light, there seems to have been a shift of resource use along a scale of preference. Robbins et al. (1916:76), for example, obliquely narrate this shift for the Tewa of San Juan Pueblo:

TABLE 2.—Plants from prehistoric Four Corners coprolites¹

Plant ²	Rank	Percentage of Coprolites containing Plant
<i>Zea mays</i>	1	87.8
<i>Opuntia</i> (prickly pear)	2	28.1
<i>Cucurbita</i>	3	25.9
<i>Chenopodium</i>	4	19.5
<i>Gossypium hirsutum</i>	5.5	16.6
<i>Physalis</i>	5.5	16.6
<i>Portulaca</i>	7	14.4
<i>Phaseolus</i>	8	13.7
<i>Amaranthus</i>	9	12.3
<i>Oryzopsis hymenoides</i>	10	11.5
Gramineae	11	10.8
Cactaceae	12.5	10.1
<i>Lepidium</i>	12.5	10.0
<i>Pinus edulis</i>	14	9.9
<i>Cleome serrulata</i>	15	7.9

¹The data base is 139 paleofeces from six sites dating to the Pueblo III period, A.D. 1100–1300. For an in-depth discussion of this study, consult Minnis (1989).

²These are the most frequently encountered plant taxa. Less commonly recovered types are: buffalo-berry (*Shepardia argentea*), bugseed (*Corispermum*), bulrush (*Scirpus*), chokecherry (*Prunus virginiana*), sunflower family (Compositae), dropseed (*Sporobolus*), *Cryptantha* sp., hackberry (*Celtis occidentalis*), horsetail (*Equisetum*), juniper (*Juniperis osteosperma*), knotweed (*Polygonum*), bean family (Leguminosae), Mormon tea (*Ephedra*), panicgrass (*Panicum*), sagebrush (*Artemesia tridentata*), saltbrush (*Atriplex canescens*), skunkbush (*Rhus trilobata*), sunflower (*Helianthus*), and wild buckwheat (*Erigonum*).

But nowadays, although wild berries and nuts are still gathered in autumn and green weeds are eagerly sought and eaten in the spring, there is a very general and increasing neglect of all but *the most common and best-liked*. Formerly it was a matter of necessity that the housewife should know them and store them; for although in normal years they were merely a pleasant addition to the diet, yet in drought, flood, fire, or a hostile raid might destroy the crops at any time, thus making the wild products an indispensable resource (emphasis added).

It is quite possible that the knowledge of foods traditionally used only during severe famines has been lost and that foods now recorded as famine foods

are those that were consumed during periods of seasonal hunger, usually the late winter and early spring when stores are depleted early in the new growing season (Richard I. Ford, personal communication, 1988). Since hunger seasons are quite common, use of these less preferred foods should be known by many individuals. Therefore, knowledge of these foods would have been less likely to have been lost than knowledge of foods used during infrequent severe shortages.

If plants that were frequently consumed become famine foods and knowledge of previous famine foods is lost, then the stability of starvation foods may also have changed. There is no reason to assume a priori that a new set of famine foods will be as resistant to the factors which reduce food availability as the previous famine foods. Thus, stability of the food supply in the face of environmental perturbations may have been reduced. I doubt that is a problem for the perennials such as inner bark, cholla, prickly pear, mesquite, and century plant. This cannot be said for the many annuals listed in Table 1, including plants such as pigweed, goosefoot, groundcherry, blazing star, and various grasses. It may well be that the presumed change in famine foods of the Desert Borderlands has resulted in a less secure strategy should the circumstances necessitate the use of least preferred foods.

Native populations in the United States and Mexico are now relatively well buffered against famine by their participation in national economies with various economic security programs. Populations in other areas may have lost the knowledge of traditional famine foods during colonial disruption of their lifestyles. In other areas of the world which have experienced substantial changes in their native subsistence practices and with less well-developed economic security programs, groups could face specially severe problems with modern food shortages after losing the knowledge of traditional famine foods.

Unfortunately, we do not have as excellent a data base as the Anasazi paleofecal inventory to assess the extent of change in famine foods for other areas of the Desert Borderlands. While it has been cogently argued that maize was the focal foodstuff for many prehistoric groups in other areas of the Desert Borderlands, the biotic communities are much different from the Four Corners. To the south, there was a great diversity and abundance of high quality foods, including various leguminous trees (e.g., mesquite, ironwood, and palo verdes), many cacti, and a wide range of agavaceous and agave-like resources (e.g., century plant, sotol, yucca, and beargrass) (Gasser 1981). In addition, recent research has identified a suite of crops present in the low deserts not documented or uncommon in the northern portions of the Desert Borderlands. Minimally, these include a barley, *Hordeum pusillum* Nutt. (Adams 1986); century plant, *Agave murpheyi* F. Gibson or *A. parryi* Engelm. (Fish et al. 1985); tepary bean, *Phaseolus acutifolius* Gray var. *latifolius* Freem. (Nabhan and Felger 1984); scarlet runner bean, *Phaseolus coccineus* L. (Ford 1981; Huckell 1986); panic grass, *Panicum sonorum* Beal. (Nabhan and de Wet 1984); and devil's claw, *Proboscidea parviflora* (Woot.) Woot. & Standl. spp. *parviflora* var. *hohokamiana* Bretting (Nabhan et al. 1981; Bretting 1982). Therefore, the example of changes in diet as discussed for the Four Corners cannot be directly extrapolated to other regions. While the individual resources may be different, the process of change, that of the replacement of an assemblage of famine food by once more common resources, may well have occurred.

Learning famine food use.—The transmittal of famine food use between generations may provide a further understanding of how this shift occurred. Not only does this topic address ethnobotanical information transfer, but it may help explain how this information is lost. Desert Borderlands data are largely silent on this issue, but research from other areas provides some illumination. Presumably, children learn food availability, distribution, collection, and processing by watching and participating in normal adult activities. Beaglehole (1937) describes one informant's recollection of the actions taken by the Hopi in response to a famine which occurred during his childhood. The simple observation of behavior is effective for learning about common foods, including foods used during yearly hunger seasons, but could well be ineffective for the use of infrequently used foods, if these severe shortages are less frequent than once per generation. If so, then other mechanisms of learning may be particularly important for famine food use.

As many have pointed out, myths, legend, rituals, and stories about previous food shortages are critical for transmitting knowledge of famine food use (e.g., Roys 1967; Reining 1970; Cove 1978; Galt and Galt 1978; Colson 1980; Marcus 1982). Thus oral tradition may be especially important in perpetuating knowledge of famine food use. Special attention should focus on women's knowledge, because they seem to have the greatest familiarity with famine foods (Ali 1984). Yet, the role of male secular and ritual knowledge of plant foods cannot be ignored as will be seen in the forthcoming Zuni example.

Several Desert Borderland examples do illustrate the perpetuation of native plant food use through ritual. Vestal (1952) mentions that several Ramah Navajo famine foods are also used ritually, although he does not provide specific information. Two examples from Zuni, however, do mention famine foods in myths or in a ritual context. Bunzel (1932:714) provides a translation of "Sayataca's night chant." In this prayer, a range of edible plants is enumerated after mention of cultigens:

. . . and then the seeds of the pinon tree, the seeds of the juniper tree, the seeds of the oak tree, the seeds of the peach tree, the seeds of the black wood shrub, the seeds of the first flowering shrub, the seeds of the *kapuli* shrub, the seeds of the large yucca, the seeds of the branched yucca, the seeds of the brown cactus, the seeds of the small cactus, and then also the seeds of the wild grasses—the evil smelling weeds, the little grass, *tecukta*, *kucutsi*, *o'co*, *apitalu*, *sutoka*, *mololoka*, *piculiya*, small *piculiya*, *hamato*, *mitaliko*, and then also the seeds of those that stand in their doorways, namely the cat-tail, the tall flags, the water weeds, the water cress, the round-leafed weed . . .

Richard Ford (personal communication, 1988), who conducts ethnobotanical research with the Zuni, points out that seeds of these native edible plants are a part of some Zuni ritual paraphernalia. Thus these plants must be collected each year, and this maintains the knowledge of the use of native plants and collection location of various foodstuffs which might otherwise be ignored. Cushing (1920:76) provides another example, the narration of a Zuni tale which mentions a time of famine and the collection of famine foods:

At last despair filled the hearts of the people of Ha'-wi-k'uh. They went forth on the mesas to gather cactus fruit but even this was scarce. When winter came the cloud swallower had gone. The god of the ice caves breathed over the whole country, and even in the Valley of the Hot Water great banks of snow fell, such as the oldest men had never seen. At last the corn was all gone. The people were pitifully poor. They were so weak that they could not hunt through the snow, therefore a great famine spread through the village. At last the people were compelled to gather old bones and grind them for meal, and for meat they toasted the rawhide soles of their moccasins.

Once a group's oral traditions are disrupted, it is very unlikely that future generations will retain knowledge of low preference foods. This problem is especially acute if famine food use is so infrequent that normal participant observation in food use is ineffective in passing this information on to future generations. If so, then plants used during hunger seasons might indeed become the only category of famine food knowledge passed on to future generations as alternative foods. An understanding of the dynamic nature of uses of plants mentioned in oral tradition is especially critical.

Famine food use as a monitor of shortage severity.—Use of famine foods may be a sensitive measure of the severity of food shortages. There are many actions people take when faced with food shortages. Such coping strategies include selling valuables, migration, stealing, change in agricultural strategies, cannibalism, raiding, and reduced or expanded cooperation within and between groups. Elsewhere I have argued that people faced with food provisioning problems choose strategies in a predictable sequence (Minnis 1985). Specifically, the least costly coping strategies tend to be used first (defining cost in cultural and social as well as economic terms). With increasing severity, more costly options will then be used. In other words, there is a "calculus" of human social and economic responses to food shortages. If so, the use of famine foods, as one such strategy, could be used to determine the severity of the shortage. Others have also suggested that the use of alternative foods, such as famine foods, may be a marker that a population is experiencing problems in food acquisition, even though signs of starvation and malnutrition may yet be lacking (e.g., Rahamani 1981; Curry 1984).

Cross-cultural study of famine foods.—The cross-cultural study of famine foods also provides a more subtle understanding of the intricate relationships between people and plants, interconnections which are not necessarily obvious from the ethnobotanical study of only one region or one population. The comparative study of famine foods has a simpler purpose and one with much practical value. Plants can be identified that are not recognized as edible within a single region, which, therefore, expands an area's practical ethnobotany.

A southwestern example includes two particularly loathsome plants. Goat's head or puncturevine (*Tribulus terrestris* L.) and burgrass (*Cenchrus* spp.) are thoroughly obnoxious weeds distributed throughout the Desert Borderlands and

whose mature fruits have sharp spines which cause much discomfort to humans and other animals; "home owners and their dogs probably dislike puncturevine more than any other weed" (Parker 1972:198). Few native or non-native inhabitants of the Desert Borderlands would recognize any value for these two taxa. Yet, these plants are described as important famine food worldwide. According to Bhandari (1974:75-77), both are important famine foods in the Rajasthan desert of India; goat's head is the "chief food of the people during the Madras Famine," and burgrass is "regarded as the most nutritious of famine foods." The Yoruba of West Africa also use goat's head as a famine food (Irvin 1952), and this plant, *chi li tzu*, is listed as a Chinese starvation food (Read 1946).

CONCLUSION

Famine foods have received little attention from ethnobotanists, relief workers, and others despite their importance throughout human history and the potential they may have for the future. Most records of their use are anecdotal and lack the detail necessary to understand their use. For example, describing the methods for the removal of toxic compounds from some famine foods is particularly important if these plants are to be used more widely, either as famine foods or in agriculture.

There are many types of famine foods, including agricultural byproducts not normally consumed, seed stock, and resources used only when more preferred foods are unavailable, either as seasonal hunger plants or used only during famines. The status of a resource as a famine food is not based solely on its biology and biochemical profile but rather also involves a range of social, cultural, political, and economic factors.

Documentation of Desert Borderlands famine foods is not as extensive as one could hope for. Yet several major categories do exist. The inner bark of some trees, such as pinyon pine, ponderosa pine, aspen, and one-seed juniper, is a major famine food, as are cacti, such as prickly pear and cholla. In addition, a number of other plants are recorded to have been used as starvation foods. These include pigweed, goosefoot, grass seeds, wild potato, globemallow, century plant, yucca, saltbushes, seepwillow, groundcherry, Rocky Mountain beeweed, bluedick, blazing star, Indian ricegrass, mistletoe, mesquite, screwbean, mangrove, rose, oak, jojoba, squaw currant, juniper, London rocket, eelgrass, nightshade, sow thistle, and others.

Many of the famine foods recorded for the Desert Borderlands are resources that we would expect to be used during food shortages. That is, most are very stable; they are perennials with an unusually effective ability to tolerate periods of low moisture, they have underground storage tissue, or they inhabit environments which are not affected by the common factors reducing resource abundance. The unexpectedly large number of annuals may reflect the historic change of hunger season plants becoming considered famine foods as a result of cultural transformations since European contact.

The brief consideration of famine foods from the Desert Borderlands of North America shows that patterns of the use of these foodstuffs changed through time

and can be an indicator of the history of changing diet. Specifically, once common aboriginal foods have become less preferred foods after domination by outside groups and with the subsequent introduction of Euro-Asian crops, new technologies, markets, and constraints on traditional catchments. It seems that these once common foods now have become famine foods for the ethnographically documented native populations of the Desert Borderlands.

Knowledge of traditional famine foods seems to be one of the first categories of native ethnobotanical information lost. Not only is this information easily lost, but it seems to be particularly difficult data to secure in the first place, perhaps partly due to the low status afforded those who must rely on such plants. Yet these plants have been critical to human survival and constitute an additional set of edible resources not normally recorded. And some of these plants may, in fact, have an as yet unrecognized economic potential. Therefore, loss of this particularly vulnerable information should concern us. The efforts to save traditional crop genotypes, knowledge of agricultural strategies and technology, and ethnobotanical information on common plant uses should also include the study of the least esteemed foods, those which have saved countless individuals and populations from starvation throughout human history.

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BOOK REVIEW

The Tropical Rain Forest: A First Encounter. Marius Jacobs, Remke Kruk et al. (editors). With a chapter on Tropical America by Roelof A.A. Oldeman and a Foreword by V.H. Heywood. New York: Springer-Verlag, 1988. Pp. 295, 157 figures and 8 plates. \$39.95 (paper). ISBN 0-387-17996-8.

This most useful book is a translation of the original Dutch version that was published in 1981. The author, Marius Jacobs, died in 1983, when he was half way through preparation of the English version. Answering a clamor from interested people who wanted it finished and published, Dr. Remke Kruk and his colleagues decided to provide an English edition with a new addition on Tropical America. As Prof. Heywood states in his foreword: "... there is still a need for a scientifically sound text which could be used by students, conservationists and other biologists who want to obtain a balanced, well-written assessment of the problems and issues involved in this unique ecosystem."

The table of contents indicates the breadth of coverage in this book: (1) A matter of public awareness; (2) How rain forests are studied; (3) Climate; (4) Soils and cycles; (5) Trees; (6) Other life forms; (7) Composition; (8) Primary and secondary forests; (9) Tropical America; (10) Malaysia; (11) Tropical Africa; (12) Relationships of plants and animals; (13) Evolution; (14) Formation of species; (15) Fringes of the rain forest; (16) Rain forest values; (17) Damage and destruction; (18) Protection; (19) Forest and man. The very extensive list of references occupies ten pages of fine print, and the detailed index comprises ten pages.

Translation or revision of the chapters was done by numerous specialists and Chapter 9, devoted to Tropical America, was newly written by Professor R.A.A. Oldeman for this edition. Several of the chapters will be of special interest to ethnobiologists.

The underlying interest in this volume is its biological and humanistic viewpoints in dealing with rain forest problems. This characteristic of the book makes it useful to both technical and educated popular audiences. With the increasing scientific, international, governmental, and popular emphasis on the urgency of conservation of rain forests, there can be no doubt about the wide acceptance and extraordinary value of this book.

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